Video Compression – HW2 (04/27/2023)

Instructions – Follow these carefully:

1. Please upload your work to Moodle. In the zip file, it must have the source code and a PDF report where you explain and display the outputs for each problem.
2. You can use either C, Python, or Matlab to do the homework work.
3. Please feel free to read related materials available in the official Matlab/Python documentation.
4. Please submit the report and code by 11:59 pm, 5/18.

In this assignment, we will use the block-based encoding approach, where the size of macroblock (MB) is 16x16. Only the Luma components is considered for the following questions.

1. (50%) Motion Estimation
   a. (35%) Please apply a block matching algorithm (16x16) to the luma component of "foreman_qcif_1_rgb.bmp" with the reference frame "foreman_qcif_0_rgb.bmp." The collocated position in the reference frame of the top-left pixel of each MB is the center of the search window. The search range is set to [-16, 15]. The similarity metric is SAD. Please print out all the MVs with their corresponding block indices (in the raster scan order https://en.wikipedia.org/wiki/Raster_scan#/media/File:Raster-scan.svg), for example:

      --MV.txt--
      Block 0 – (0, 0)
      Block 1 – (2, 4)
      Block 2 – (2, 5)
      …

   b. (15%)
      Make a collage for all the reference blocks as a frame that corresponds to foreman_qcif_1_rgb.bmp. Please show the collage in your report and save it as a grayscale image.

2. (50%) Intra Frame Prediction
   a. (35%) Please apply intra prediction to the luma component of "foreman_qcif_0_rgb.bmp." You only need to implement the four modes (Mode 0, 1, 2, and 4) for the 16x16 luma MB. You do not do intra prediction to the top-left MB since there is no predictor for it. The similarity metric is also SAD. If there are any pixels unavailable for a mode, you cannot choose it (using -1 as its mode number). Please print out all the prediction modes with their corresponding block indices in the raster scan order.

--MV.txt--
Block 0 – -1
Block 1 – 1
Block 2 – 1
…

b. (15%)
Please make a collage for all the reference blocks (filled out with all the predictors only) as a frame that corresponds to foreman_qcif_0_rgb.bmp. Please show the collage in your report and save it as a grayscale image.